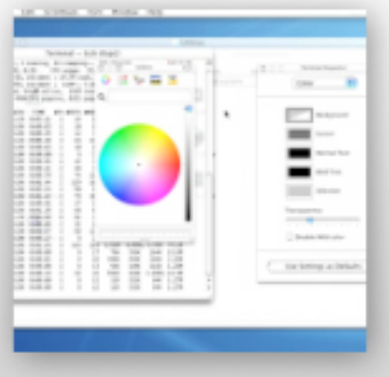
Rendezvous

Zero Configuration Networking

Session 105



Rendezvous
Zero Configuration Networking

Craig Keithley
I/O Technology Evangelist
keithley@apple.com

Introduction

- What is Rendezvous?
- What's Happened in the Last Year?
- New Features
- New APIs for Software Developers
- Hints for Software Developers
- Hints for Hardware Developers
- Q&A

Rendezvous
Zero Configuration Networking

Stuart Cheshire
Rendezvous Architect
cheshire@apple.com

What Is Rendezvous?

- Why?
  - Local Area Communications (0–10m) chaos
- What?
  - Wide Area has converged on IP as the One True Protocol—why not Local Area too?
- How?
  - How do we make IP meet this challenge?

Why?

Wide Area Convergence

- DECnet
- Xerox XNS
- TCP/IP
- OSI
- ATM-to-the-desktop
- IBM/Microsoft NetBEUI
- AppleTalk
- Etc., etc., etc.

Wide Area Convergence

- DECnet
- Xerox XNS
- TCP/IP
- OSI
- ATM-to-the-desktop
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- Etc., etc., etc.

Local Area Chaos

- Parallel Ports
- Serial Ports
- SCSI
- ADB
- IrDA

Local Area Chaos

- Parallel Ports
- Serial Ports
- SCSI
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Local Area Chaos

- USB
- FireWire
- Ethernet
- 802.11b
- ATA
- Bluetooth

Local Area Chaos

- USB 2.0
- FireWire 800
- Gigabit Ethernet
- 802.11g
- Serial ATA
- Bluetooth 2.0
- UWB (Ultra Wide Band)
- NFC (Near Field Communication)

What?

Pick One Protocol

- Wide Area Communications have already converged on IP
- Why not Local Area Communications too?

How?

Rendezvous

Rendezvous

“It’s Like a Backstage Pass to the Future”

Jared White, The Idea Basket

Rendezvous

“Rendezvous is truly revolutionary. It’s one of the things that is going to have the largest impact on application design over the next couple of years.

We’re just at the beginning of the second internet revolution, and Rendezvous is a big part of it.”

Tim O’Reilly, President, O’Reilly & Associates

Three Legs of Rendezvous

- Addressing
- Naming
- Browsing

Addressing

- Self-Assigned Link-Local Addressing
  - Pick random address in 169.254/16
  - ARP to see if anyone else is using it
  - If someone else is using it, try again
  - Ongoing conflict checking
- draft-ietf-zeroconf-ipv4-linklocal-08.txt
- http://www.zeroconf.org/

IPv4 Link-Local Availability

- Self-Assigned IPv4 Link-Local Addressing first appeared in:
  - Mac OS 8.5, Summer 1998
  - Windows 98, Summer 1998
  - Mac OS X 10.0
  - ZCIP for Linux <http://zeroconf.sourceforge.net/>
- You may know it as Autonet, AutoIP, etc.
- IPv6 already has Link-Local Addressing

Naming

- Multicast DNS
  - Pick desired name in ".local." subdomain
  - Issue Query to see if anyone else is using it
  - If someone else already using it, pick another
  - Ongoing conflict checking
- draft-cheshire-dnsext-multicastdns-02.txt
- http://www.multicastdns.org/

Multicast DNS Availability

- Multicast DNS client
  - Mac OS 9.2
  - Mac OS X
  - Linux: tmdns <http://dotlocal.org/>
  - Windows: "Considering / Underway"
    (Brian Zill, Microsoft, IETF Plenary Presentation, July 2002)
- Just type
  - "laserwriter.local." into your Web browser
  - "ssh mymac.local." into a terminal window

Browsing

- Raising the bar
- Should not need to know name in advance

DNS Service Discovery

- Devices already need:
  - IPv4 Link-Local Addressing
  - Multicast DNS
- Don’t need more code
  - Multicast DNS gives us Service Discovery too

Browsing Via DNS PTR

- DNS Query:

  _ipp._tcp.local. PTR ?

Browsing Via DNS PTR

- DNS Response(s):

_ipp._tcp.local. PTR Sales._ipp._tcp.local.
Marketing._ipp._tcp.local.
Engineering._ipp._tcp.local.
3rd Floor Copy Room._ipp._tcp.local.

Components of Service Name

- User-Visible Name
  3rd Floor Copy Room._ipp._tcp.local.
- Service Type/Service Protocol Name
  3rd Floor Copy Room._ipp._tcp.local.
- Domain
  3rd Floor Copy Room._ipp._tcp.local.

Service Types

- A Service is identified by what protocol it uses
- Protocol names are assigned by IANA
  - Internet Assigned Numbers Authority
- List of assigned protocol names
  http://www.iana.org/assignments/port-numbers
- Applying for your own is easy
  http://www.iana.org/cgi-bin/usr-port-number.pl

Lookup Via DNS SRV

- DNS Queries:

```
Sales._ipp._tcp.local.      SRV      ?
Sales._ipp._tcp.local.      TXT      ?
```

Lookup Via DNS SRV

- DNS Responses:

```
Sales._ipp._tcp.local.    SRV     0 0 631 my-printer.local.
Sales._ipp._tcp.local.    TXT   pdl=application/postscript
my-printer.local.         A                 169.254.12.34
```

DNS-SD Availability

- On OS X 10.2 onwards:
  - System API
- Other Platforms:
  - Use Apple's Darwin Open Source
  - Other Independent Implementations
  - Implement from spec: draft-cheshire-dnsext-dns-sd-01.txt
- http://www.dns-sd.org/

What's Happened In the Last Year?

Mac OS X 10.2 Jaguar

- iChat
- Printing
- AppleShare
- Remote AppleEvents

Mac OS X 10.2.x Updates

- Advertise more services:
  - http
  - ftp
  - ssh

Apple Products

- Apple Hardware Products
  - AirPort Extreme Base Station
  - Xserve RAID
- Apple Software Products
  - Safari
  - iTunes 4
  - Shake Qmaster Network Rendering

Third-Party Hardware Products

- Printers
- SEH Intercon Print Server
- SitePlayer
- TiVo
- SliMP3
- Chaparral RAID
- Martian NetDrive

…and many more we still can’t talk about publicly

Third-Party Software Products

- Sybase
- NASCAR Racing 2002
- Gridlock 1.1 network chess
- Worldbook Encyclopedia
- iChalk, iStorm (Math Game House Software)
- Hydra
- Camino Web browser
- Transmit, Interarchy, Captain FTP
- ClipboardSharing
- Etc., etc., etc.

Other Platforms

- Crocodile Rendezvous FTP server for Windows
- Swampwolf
  - Rendezvous system service for Windows and Linux
  - Windows Internet Explorer Rendezvous plugin
- jRendezvous Rendezvous in pure native Java
- PyRendezvous Rendezvous in Python
- Linux mdnsd, tmdns, etc.

  http://dotlocal.org/
- Etc., etc., etc.

Demo

Stuart Cheshire
cheshire@apple.com

New Features

What's New In Panther?

- Full IPv6 support
- Sub-type browsing
- Performance improvements
- Better network efficiency
- Faster purging of stale data
- Enumeration of all services on the network
- New clients
- Improved APIs

Faster Cache Purging

- If Resolve() fails
  - PTR Record reconfirmed
- If Reconfirm fails
  - Record removed from browse list
- When other clients observe failed queries
  - Also remove records from their lists

Future Plans

- Global Rendezvous
  - Standard DNS Server
  - DNS Dynamic Update
  - Unicast DNS queries
  - Delegate Rendezvous subdomains

Demo

Stuart Cheshire
cheshire@apple.com

New APIs for Software Developers

New APIs

- NSNetServices APIs unchanged
- CFNetServices APIs unchanged
- DNSServiceDiscovery APIs updated
  - Old Jaguar calls still work, but deprecated

Rendezvous Architecture

DNSServiceRegister()

- Improves on DNSServiceRegistrationCreate()
  - Can advertise on specific interface
  - Informs client of chosen name
  - 768 byte TXT record limit raised to 1400 bytes
  - Can register true binary TXT records
  - Adds placeholder names

DNSServiceBrowse

- Improves on DNSServiceBrowserCreate()
  - Can browse on specific interface
  - Replies contain Interface ID

DNSServiceResolve

- Improves on DNSServiceResolverResolve()
  - Uses Interface ID from browse call
  - Doesn't have to fetch IP + Port + TXT
  - 768 byte TXT record limit raised to 1400 bytes
  - Can fetch true binary TXT records
  - More efficient on the network

New Calls for Specialized Clients

- DNSServiceRegisterRecord()
  - Register any arbitrary record
- DNSServiceQuery()
  - Query for any arbitrary records
- DNSServiceReconfirmRecord()
  - Signal stale cache data

Hints for Software Developers

Hints for Software Developers

- Use Rendezvous APIs in your Mac OS X applications:
  - NSNetServices
  - CFNetServices
  - DNSServiceDiscovery
- Use the Rendezvous logo on your packaging

The “Rendezvous Name”

- Two kinds of names:
  - Host names
    - short, easy to type
    - only letters, digits, hyphens
  - Service names
    - long, descriptive
    - full rich-text Unicode
- Use "" (empty string) when registering services

Register Your Service Type

- Protocol names are assigned by IANA
  - Up to 14 characters, letters and digits only
- Applying for your own is easy and free
  http://www.iana.org/cgi-bin/usr-port-number.pl

Use "" (Empty String) for Domain

- Equivalent to ".local." on Mac OS X 10.2
- Future Compatibility with Dynamic Update

Resolve on Demand

- Don’t Resolve every service you find
  - Wastes bandwidth
  - Stale data
- In Preference files

DO save service name

DON’T save IP address and port

Don’t Assume IPv4

- Resolves will now return IPv6 addresses

Cancel Resolves!

- After successful connection:
  - Cancel Resolve
- Active Resolve consumes:
  - Memory
  - CPU time
  - Kernel resources
  - Network bandwidth
- Can’t cancel a Resolve:
  - using "didRemoveService" NSNetService
  - using "browse callback" CFNetServiceRef

Don’t Overload Rendezvous

- Rendezvous does discovery
  - Does not replace your application’s network protocol
  - Use dynamic TXT record update sparingly

Network Protocol Design

- Don’t Overload the Network
  - **NO** Periodic Announcements!
- Don’t Assume Fixed TCP port
  - With Fast User Switching, your port may be occupied

Look at the Network Packets

- Standard DNS Packet Format
- On UDP Port 5353 (instead of 53)
- View the packets using EtherPeek, tcpdump, etc.
- Older versions:
  - Edit EtherPeek.app/Contents/decoders/IETF.dcd

```
TEQU  19   2  0  0  SMTP;
TEQU  35   2  0  0  DNS;
TEQU  14e9 2  0  0  DNS;
TEQU  50   2  0  0  HTTP;
TEQU  6d   2  0  0  POP;
```

http://www.multicastdns.org/

Hints for Hardware Developers

Basic Steps

1. All three legs of Rendezvous
2. Pass Apple Rendezvous Conformance Test
   http://developer.apple.com/mkt/swl/agreements.html
3. Put Rendezvous Logo on your product

Don’t Skip Link-Local Addressing

1. Pick random IP address in 169.254/16
2. Send ARP Request for chosen address and wait a bit
3. If ARP Response received, goto 1

What Would USB Do?

- Don’t make user wait
  - Assign Link-Local address quickly
- Don’t make user power-cycle device
  - Use link-change detection
- If in doubt, compare with USB

Use Our mDNS-SD Code

- Royalty-free Darwin mDNS-SD code
- Under 5000 lines of C, 75K compiled PowerPC:
  - IPv4 and IPv6
  - mDNS client and responder
  - DNS-SD client and responder
- Even smaller implementations in development
  - Contact us for your project

Wrap Up

Roadmap

102 Open Source at Apple
Apple's open source projects and infrastructure
Mission
Tues., 10:30am

110 Networking
Overview of Mac OS X Networking APIs
Mission
Thur., 10:30am

FF015 Networking Feedback Forum
Internet and Networking Technologies
Mission
Fri., 10:30am

112 CFNetwork in Depth
Technologies inside CFNetwork and related APIs
Pacific Heights
Fri., 5:00pm

Who to Contact

Craig Keithley
Apple Worldwide Developer Relations
keithley@apple.com

http://developer.apple.com/wwdc2003/urls.html

For More Information

Reference Library

External Web Sites

Zero Configuration Networking
http://www.zeroconf.org/

Multicast DNS
http://www.multicastdns.org/

DNS Service Discovery
http://www.dns-sd.org/

Reference Library

Apple Web Pages

Apple Developer Information
http://developer.apple.com/macosx/rendezvous/

Source Code from Darwin CVS Server
http://developer.apple.com/darwin/projects/rendezvous/

Join the Rendezvous Mailing List
http://lists.apple.com/mailman/listinfo/rendezvous

Q&A

Craig Keithley
I/O Technology Evangelist
keithley@apple.com

http://developer.apple.com/wwdc2003/urls.html

WWDC 2003

Worldwide Developers Conference